REMARKS/ARGUMENTS

Applicant thanks the Examiner for the allowance of claims 15-22 and 35-44.

The Examiner rejects claims 1-10 under 35 U.S.C.§102(b) as being anticipated by Kumar et al. (U.S. 6,612,245) and claims 11-14 under 35 U.S.C.§103(a) as being unpatentable over Kumar et al. in view of Engle (U.S. 5,564,795).

Applicant respectfully traverses the Examiner's rejection for the reasons set forth below in connection with each set of rejected claims.

Claims 1-4

Applicant respectfully submits that Kumar et al. does not teach or suggest at least the following italicized features of independent claim 1:

> 1. A locomotive, comprising:
>
> a plurality of direct current traction motors corresponding to a plurality of axles and a plurality of drive switches, each traction motor operating in a driven mode and a free-wheeling mode, wherein in the driven mode a power pulse from an energy storage device passes through the traction motor and the corresponding drive switch and *in the free-wheeling mode the power pulse from the energy storage device passes through the traction motor and bypasses the corresponding drive switch*;
>
> *a plurality of filters, each filter corresponding to one of the plurality of direct current traction motors, to absorb electrical voltage transients and smooth current ripples through the traction motors resulting from changes between the driven and free-wheeling modes*; and
>
> *a controller operable to determine a respective power requirement for each traction motor during a selected time interval and the necessary amplitude and pulse width of a power pulse to produce the determined power requirement for each traction motor, wherein during the selected time interval the respective power requirements of at least two traction motors are different.*

Kumar et al. is directed to an energy tender for use in connection with a hybrid energy locomotive system having an energy storage and regeneration system. The energy storage and

regeneration system captures dynamic braking energy, excess motor energy, and externally supplied energy in one or more energy storage subsystems, including a flywheel, a battery, an ultra-capacitor, or a combination of such systems. In one form, the energy storage and regeneration system is located in the energy tender vehicle. The energy tender vehicle is optionally equipped with traction motors. In one form, the energy tender is configured to operate without any power connections to the locomotive. An energy management system is responsive to power storage and power transfer parameters, including data indicative of present and future track profile information, to determine present and future electrical energy storage and supply requirements. The energy management system controls the storage and regeneration of energy accordingly.

In Figs. 1B, 2-5, and 9A-11, various locomotive architectures are depicted. None of the architectures include a plurality of filters, each filter corresponding to one of the plurality of direct current traction motors, to absorb electrical voltage transients and smooth current ripples through the traction motors resulting from changes between the driven and free-wheeling modes.

Moreover, Kumar et al. does not teach separate control of the traction motors using a chopper circuit or an equivalent thereof. Chopper circuits, DBC1 and DBC2, are included in the architectures of Fig. 9B. The chopper circuits allow fine control of power dissipation through the charging grids, which therefore provides greater control over the storage elements.

<u>Claims 5-7</u>

Applicant respectfully submits that Kumar et al. does not teach or suggest at least the following italicized features of independent claim 5:

5. A locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

a plurality of electrical storage subunits to receive, store, and supply the direct current electricity, *wherein in a first mode the electrical storage subunits are connected electrically in series and in a second mode the electrical storage subunits are connected electrically in parallel;* and

at least one switch to switch the electrical storage subunits between the first and second modes.

The Examiner asserts that "[a]s shown in figure 11 the switches allow for the batteries 1102 to be connected to the traction motors 208 either in series or in parallel pending on the position of the switch 1104. Contrary to the Examiner's position, Kumar et al. teaches that the batteries are either connected or disconnected by the switch and not placed in series or parallel. At col. 24, lines 51-57, Kumar et al. states:

> The general operation of the configuration of FIG. 11 will be described by reference to the connection state of transfer switch 1104. When transfer switch 1104 is in the first switch state, the sixth axle is selectively used to provide additional motoring or braking power. In this switch state, battery 1102 is effectively *disconnected and, therefore, neither charges nor discharges.*

(Emphasis supplied.)

Claims 8-10

Applicant respectfully submits that Kumar et al. does not teach or suggest at least the following italicized features of independent claim 8:

8. A locomotive, comprising:
a plurality of direct current traction motors in communication with a plurality of axles;
a prime energy source;
an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;
an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity, wherein the energy storage device comprises a plurality of capacitors operable to store the stored energy; and
a pulse forming network to maintain the output power pulses of the energy storage device at least substantially constant in magnitude.

The Examiner correctly notes that Kumar et al. teaches the use of ultra-capacitors as energy storage devices. However, unlike batteries which provide a substantially constant voltage output, capacitors provide a decaying voltage output. As the capacitors discharge and lose energy, the output voltage of the capacitors decreases non-linearly (capacitor energy is $\frac{1}{2}CV^2$ where C is the capacitance and V is the voltage). Kumar et al. is silent on how to modify the decaying voltage waveform to a form that is compatible with operational components, such as traction motors, requiring a constant input voltage waveform. Applicants have recognized that a pulse forming network, such as a buck-boost chopper circuit or power conditioning circuit, is necessary to overcome this problem.

<u>Claims 11-14</u>

Applicant respectfully submits that Kumar et al. and Engle do not teach or suggest at least the following italicized features of independent claim 11:

11. A locomotive, comprising:
a plurality of traction motors in communication with a plurality of axles;

a prime energy source for providing power to the plurality of traction motors; and

a plurality of air brake systems operatively engaging a respective one of the plurality of axles, each air brake system comprising at least one movable braking surface element and corresponding air-brake cylinder and *a fluid-activated brake release,* wherein, when a moveable braking surface element is locked in position against a braking surface, *fluid pressure is applied against the braking surface by the fluid-activated brake release to disengage the locked moveable braking surface from the braking surface.*

While conceding that Kumar does not disclose the use of a braking system on a locomotive, the Examiner asserts that Engle teaches the claimed air brake assembly.

Applicants disagree.

Engle is directed to a braking system including a brakepipe control valve which controls pressure on a brakepipe in response to braking pressure signal from an electropneumatic converter. A cutoff valve connects the control valve to the brake pipe. A controller controls the converter and cutoff valve. A parking brake system and retarder control system are also included and are controlled by the controller.

To effect brake release of the brakes, Engle, at col. 7, lines 21-40, teaches that the brakepipe cutoff valve 214 is energized and all three pilot solenoids on the converter valve 212 are de-energized. As a result, flow from the brakepipe control valve 210 to the brakepipe line 124 is unrestricted. No air, however, is provided to the reduction or brake control signal chamber 262 of the control valve 210. Feed valve air on passage 246 is provided to the top chamber 252 of the large control diaphragm 250 forcing it downward and opening the release valve 278. This action allows air from the main reservoir passage 242 to pass into the output chamber of the control valve and

supply the brakepipe line 126 while at the same time entering the chamber 254 beneath the large control diaphragm 250 urging it upward. When brakepipe pressure rises to equal the value of the feed valve pressure on top of the diaphragm 250, the operator or valve stem 272 will move up, closing the release valve 278 and cutting off further flow of main reservoir air passage 242 to the brakepipe line 124 at feed valve or full release pressure.

To effect release of the parking brake, Engle at col. 9, lines 42-50, states that all controllers 68 de-energize their parking brake release valves 226. This permits feed valve air on passage 246 to pressurize the parking brake release pipe 126 which is connected from each manifold to the motorized trucks. At the individual trucks, this pressure fills the spring brake actuators 130, compressing their application springs and releasing the parking brakes.

Engle teaches away from the present invention. Engle does not teach or suggest applying fluid pressure against the braking surface to disengage the locked moveable braking surface. To the contrary, Engle teaches releasing fluid pressure exerted against the braking surface to effect release of the brakes.

Claims 23-34 and 45-48

Applicant respectfully submits that Kumar et al. does not teach or suggest at least the following italicized features of independent claims 23, 29, 45, and 47:

> 23. A locomotive, comprising:
> a plurality of direct current traction motors in communication with a plurality of axles;
> a prime energy source;
> an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

a controller operable to (I) monitor an operational parameter of each of the plurality of axles and/or traction motors, wherein the monitored operational parameter includes (a) an electrical current and/or voltage output by the energy storage device and (b) a state of charge and/or voltage of the energy storage device, and (ii) in response to the monitored operational parameter, control operation of the prime energy source.

29. A method for controlling the operation of a locomotive, comprising:

(a) providing a locomotive, the locomotive comprising:

(I) a plurality of direct current traction motors in communication with a plurality of axles;

(ii) a prime energy source;

(iii) an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity; and

(iv) an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

(b) *monitoring an operational parameter of each of the plurality of axles and/or traction motors, wherein the monitored operational parameter includes (a) an electrical current and/or volts output by the energy storage device and (b) a state of charge and/or voltage of the energy storage device* and

© *in response to the monitored operational parameter, controlling activation and deactivation of the prime energy source to control provision of direct current electricity to the energy storage device.*

45. A power control system for a locomotive, comprising:

a plurality of direct current traction motors in communication with a plurality of axles;

a prime energy source;

an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive, store, and supply the direct current electricity;

a user interface operable to receive a command from an operator to control a locomotive speed at a specified velocity;

a controller operable to determine an electrical current passing through each of a plurality of direct current traction motors; and

a graphical user interface operable to display a current power being delivered by the energy storage device, a voltage of the energy storage device, an electrical current of the energy storage device, and a state of charge of the energy storage device to permit the operator to monitor a state of the energy storage device.

47. A power control method for a locomotive, comprising:

providing a locomotive comprising:

(I) a plurality of direct current traction motors in communication with a plurality of axles;

(ii) a prime energy source;

(iii) an energy conversion device, in communication with the prime energy source, to convert the energy output by the prime energy source into direct current electricity;

(iv) an energy storage device, in communication with the energy conversion device and the plurality of traction motors, to receive and store the direct current electricity;

(v) a user interface operable to receive a command from an operator to control a locomotive speed at a specified velocity;

displaying a current power being delivered by the energy storage device, a voltage of the energy storage device, an electrical current from the energy storage device, and a state of charge of the energy storage device; and

receive commands from the operator in response to the displayed information.

While conceding that Kumar et al. does not teach or suggest a controller to monitor an operational pattern of the axles and the traction motor and electrical current provided to the traction motor or the use of a graphical user interface to provide the operator with measured parameters, the Examiner asserts that it is obvious to apply a controller, like that described in Kumar et al. (880) to a traction motor circuit like that of Kumar et al. and to use a graphical user interface in the manner claimed.

Applicants disagree.

Kumar et al. fails to teach or suggest the importance of (I) monitoring an operational parameter of each of the plurality of axles and/or traction motors, wherein the monitored operational parameter includes (a) an electrical current and/or voltage output by the energy storage device and (b) a state of charge and/or voltage of the energy storage device, and (ii) in response to the monitored operational parameter, controlling operation of the prime energy source. The state of the battery and rate of discharge of the battery is important to maintain the battery temperature within a specified safe range, to prolong battery life, and to control operation of the prime energy source efficiently and effectively with respect to work cycles of the locomotive.

Accordingly, the pending claims are allowable over the cited references.

The dependent claims provide further reasons for allowance.

Based upon the foregoing, Applicants believe that all pending claims are in condition for allowance and such disposition is respectfully requested. In the event that a telephone conversation would further prosecution and/or expedite allowance, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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